REPORT OF

NINTH ANNUAL
Date Grower's Institute

HELD IN

COACHELLA VALLEY

CALIFORNIA

MARCH 26, 1932

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Ninth Annual

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Ninth Annual Date Growers Institute

Morning Session, Saturday, March 26, 1932

Dr. L. D. Batchelor, Director of Citrus Experiment Station, Riverside, Presiding

Dr. L. D. Batchelor: It has been a pleasure and responsibility for the various members of the Citrus Experiment Station to attend the Date Institute for several years in the past. I want you to feel that we are especially mindful at this time of the responsibility which we have in the Research Department toward the problems of the date grower. I want also to convey the idea, and impress upon your mind, that the problems with which the date industry has been confronted, are similar to the problems of other industries in Southern California.

The name of the institution which I represent, the Citrus Experiment Station, is somewhat of a misnomer at the present time, and although we have existed since 1914 as the Citrus Experiment Station, we have gradually evolved, until at the present time somewhat less than one-half of the research projects of the institution have to do with citrus. In other words, our interests have expanded to include practically all agricultural crops common to Southern California.

You might ask why we do not change the name. There is no reason, except possibly of sentiment. Those of us who have grown up with it have a sentimental interest in retaining that name. If you will recall, the reputation of the Citrus Experiment Station, it has, among other institutions of the world, an enviable position. Although we are not strictly a citrus experiment station, we don't want to change the name. We might compare this to other institutions like the Southern Pacific and their Sunset Limited. There might be many other names for that train, but they probably have some sentimental reason for retaining that name on that particular train.

The broad interest that the Citrus Experiment Station has at the present time, includes all crops grown in Southern California. Quite a number of them have many serious problems confronting them, like the date industry. This is more or less inherent to the growth of any new crops. Differing from Eastern states, most of the agriculture in Southern California is in a pioneer stage. Especially in dates, avocados, even with citrus and walnuts.

I won't go to any great length in describing some of the complicated and perplexing problems before the Citrus Experiment Station regarding the control of insects, diseases, both on avocados, citrus, and walnuts, but assure you they are as complicated as those of the date industry. I do not refer especially to the economic condition as it exists at the present time—that is a widespread problem all over the world, and it is not peculiar to Southern California agriculture.

I make these preliminary remarks with reference to our broad interests in order that we may assue you that in our research work in Southern California, the workers in the Citrus Experiment Station, are as much interested in the date industry as in the citrus, in cantaloupes as in avocados. We have no foster industries, no foster districts. We try to take the most general and broad interest in agriculture in Southern California. It is not always possible to make a response in harmony with the requests of various industries. Our budget is limited, the people working there are limited. At times our budget is rather inflexible to allow us to adjust our program to the needs of the industries.

I wish to especially compliment the date industry and the people who are working so hard in the industry, with the tolerance and patience with which they have made their requests for special research work on date problems. Obviously they have understood our inflexible program, and have been patient with our working out a modified program to include more work on dates. In that respect, I wish to call your attention to the recently published bulletin by Doctors Fawcett and Klotz on date diseases. This is a problem which they have worked on for a considerable length of time, and have made real progress. At the present time, Doctor Bliss, of the Citrus Experiment Station, is working almost exclusively on the diseases of the date palm.

Perhaps we had better turn now to the prepared program for the morning session.

Afternoon Session, Saturday, March 26, 1932

Dr. E. P. Clarke, Editor of Riverside Daily Press, Presiding

E. P. Clarke: I expect it is quite likely that some of you date growers have asked yourselves what a newspaper man would know about the date industry. My guess would be that your natural and logical answer would be "Not a darn thing." In a sense that is true, however I have had the responsibility of editing the leading paper in Riverside county for nearly 40 years. In that position, I could not fail to recognize the growth and importance of the date industry—its present and future value in the prosperity and growth of the county.

Some weeks ago, your farm advisor, Mr. Winslow, and I fell into a conversation about the date industry. He was telling me about an experience he had of trying to buy California dates. This particular store in Riverside county had nothing but imported dates, and we had quite a discussion as a result of his experience.

I embarked in the newspaper business in Ontario in 1885. The first oranges produced in Ontario were grown that year—a great curiosity. The foundation was being laid for the great citrus industry. In 1894 I transferred my newspaper activities to Riverside. I have been there ever since. There was a panic in 1893 (they called them panics in

those days, not depressions) and all lines of agriculture suffered with other businesses. A serious depression was felt for several years afterward.

The citrus industry was suddenly in a terrible condition. The only means growers had to sell fruit was through the commission men. The usual experience was that, after fruit had been shipped East and sold, the grower would get a bill for the freight. Finally they got desperate. In the fall of 1894 a little group of growers in Riverside got together and started the Cooperative Citrus Growers' Association. It was the beginning of the present California Fruit Growers' Exchange. That institution has developed into the greatest and most successful cooperative growers' organization in the entire world.

At the time this beginning was made, we were shipping about 15,000 cars of citrus fruit. Now it is around 80,000 cars. Largely through the Exchange, which controls 80% of the California crop, we have developed a system of grading such that buyers can buy any quality fruit desired. Through the years, a great advertising campaign has been worked out—a most important factor in developing demand. Then marketing machinery has been developed, and so completely organized that California citrus fruit is available to practically every home in the country. That service costs the growers only about 12c per packed box, on the average.

It would be foolish to claim on behalf of the citrus industry that it is at the present time a highly profitable industry. It is less unprofitable than any other form of agriculture in the country. (Unless possibly the walnut industry.) There are two things I want to emphasize and give the Exchange credit for. The distribution is so complete that the entire crop is absorbed, and the grower gets the money the fruit actually sells for, less small cost of the marketing machinery of the Exchange. It is strictly cooperative.

I am citing these facts as some suggestion of encouragement to you engaged in the date industry. This industry is in its infancy and is going through some of the same experiences the citrus industry did some 40 years ago. I see no reason, in view of the limited area where dates can be grown successfully, why machinery and marketing set-ups cannot be brought to you, and give you the benefits received by citrus growers.

Observations on the Occurrence of Blacknose

By Roy W. Nixon, Associate Horticulturist, U. S. Experiment Date Garden, Indio, California

"BLACKNOSE" is a name commonly applied to the abnormally shrivelled and darkened tip of a date. As it appears on Deglet Noor fruit it is accompanied and preceded by numerous, small, transverse checks or breaks in the skin in the apical portion. In fact, pronounced shrivelling and darkening usually occur in proportion to the abundance of the checks. Dates with only a few checks may show no evidence of shrivel nor otherwise be lowered in quality except as their appearance is affected by the scars. At the other extreme are dates so badly checked and shrivelled as to be almost worthless. In between are all gradations of injury. A certain proportion of Deglet Noor fruit affected with blacknose can be found in nearly all commercial gardens and in some localities and in some years it is a source of considerable loss.

What is probably a similar injury occurs in many other varieties, but the checks are often irregular, sometimes longitudinal rather than transverse and not always confined to the apical portion of the date, as a consequence of which there may be little resemblance to the blacknose of Deglet Noor.

Recent investigations by Dr. L. J. Klotz of the Citrus Experiment Station at Riverside, reported at the Seventh and Eighth Annual Date Growers' Institutes, indicate that blacknose is of physiological rather than of pathological origin. Important chemical and physiological studies of dates so affected are also being made by Dr. A. R. C. Haas of the same station. Only such investigations can reveal the nature of the internal changes which take place in the fruit during the development of the disorder and the extent to which nutritional or funtional disturbances may be responsible for the trouble. Meanwhile, the more obvious, but none the less important, environmental factors involved in the production of blacknose have remained obscure.

The pollination experiments which the writer has been conducting for a number of years have afforded an opportunity to observe the occurrence of blacknose under varying conditions which throw some light upon the problem, and some few experiments have been made which may be of interest to growers.

In 1927 in two pollination tests each on a single bunch on a different Deglet Noor palm at the Narbonne Ranch, bags which had been placed over the strands and bunches and which were to have been removed a few weeks later by the foreman, were overlooked and allowed to remain until late in the summer. While more or less broken by the growth of the dates, the bags, especially the outer ones of heavy brown paper, afforded some protection until they were removed. When the experiments were checked on September 27th a striking contrast was found. With the exception of the dates which had been bagged the fruit on every bunch on each of the two palms in question was very seriously affected by blacknose, the proportion being estimated at 50 to 75 per cent. On the experimental bunches there was no blacknose at all, only the merest trace of checking on an occasional date.

Mr. T. J. Gridley, Superintendent of the Narbonne Ranch, told the writer at the time that he believed showers or traces of rain in the middle or latter part of the summer had something to do with blacknose. However, as the dates in these experiments had been bagged since pollination it was by no means certain then that it was not protection afforded in early spring that had prevented the blacknose.

Owing to the absence of the writer in Iraq further investigations were deferred until the summer of 1930, when examinations of fruit were made at intervals throughout the season. A week of relatively high humidity with local traces of rain occurred about the middle of July. Within ten days very small apical checks were observed for the first time on a small percentage of dates at both the U. S. Experiment Date Garden and the Narbonne Ranch. Later the dates on which they occurred in abundance developed typical blacknose. The crop as a whole was quite green—too immature to be much affected at the time when injury took place. The checks were noted as occurring on dates which though still green were beginning to fade a little preparatory to turning pink.

It is more common for cloudy weather and light local showers or traces of rain to occur in August than in July, but August, 1930, was unusually clear and dry and the following September and October were ideal for the ripening of dates. This season was characterized by very little blacknose as compared with other years. Where it appeared it was mostly on small palms and on bunches of fruit suspended close to the ground in irrigation basins frequently filled with water—conditions which have already been observed by growers to favor the occurrence of blacknose.

A very clear cut instance of the relation of blacknose to moisture was observed at the Andreas Canyon substation of the U. S. Experiment Date Garden in 1930. Rain fell to the extent of 2.03 inches at this garden in 1 hour and 45 minutes on August 1st. This local cloudburst caused a flood of about 18 inches of water to sweep over the garden. Most of the Deglet Noor palms there are small and many of the bunches of fruit hung so close to the ground that they were entirely covered by the water for an hour or more. Much straw and leaves lodged in these bunches and kept them damp for some time after the water subsided. There were other bunches on the same palms which were too high to be reached by the water. On the low bunches typical blacknose developed on a large percentage of the dates. On the high bunches very little blacknose appeared.

The summer of 1931 afforded an excellent opportunity to observe the weather conditions which favor the production of blacknose. The humidity during August was relatively high. The total rainfall as recorded at the U. S. Experiment Date Garden was .24 inch with traces or measurable amounts on 8 days, 7 of which occurred between the 3rd to 20th inclusive with 15 cloudy days in the same period. Early in the month there were a number of local show-

ers. On August 5th there was a heavy shower in the vicinity of the Narbonne Ranch accompanied by a flood from the mountains which did some little damage by washing away borders and some of the top soil. On August 7th an examination was made of Deglet Noor dates at the Narbone Ranch. It was estimated that from 25 to 50 per cent of the fruit showed small, transverse breaks in the skin of the distal portion. These checks appeared fresh and undoubtedly had occurred during the several humid days preceding the date of observation.

The fruit affected was all in the same stage in which the injury had been noted as occurring the previous summer—namely green, fading a little preparatory to taking on the khalal red. By August 1st about half of the Deglet Noor dates at the Narbonne Ranch had already acquired definite pink tints. Practically none of these pink dates showed the blacknose checks. A few of them where moisture had collected on the tips were ruptured with the larger, irregular, and more severe splits in the skin of the type familiar as a result of rains in September and October, but on the whole there was little injury to the early fruit, which produced most of the better grades at the Narbonne Ranch during this season, whereas the later fruit which was injured during the humid weather early in August developed pronounced blacknose and was a source of heavy loss.

During both 1930 and 1931 numerous tests of the effect of moisture on the skin of dates were made by the simple method of putting specimens in various stages of maturity into jars of water. Deglet Noor dates of a pronounced green color are apparently very little affected by immersion in water. When the color is definitely pink or coral red the skin is ruptured in a violent manner by relatively short exposures, a few hours commonly producing results similar to what occurs as a result of a heavy rain at this stage. In between these two extremes there is a gradation of reaction to water. Dates still green but beginning to fade a little prior to acquiring pink tints developed small, transverse checks, similar to those which precede blacknose, after about a day in water, in some instances with less exposure and in others with more, depending on the relative maturity. Dates in this stage on the palm are apparently injured in much the same way by light showers and condensation of moisture on the surface at night during humid weather and by amounts of moisture which may be insufficient to cause splitting of the pink or red dates. Minute droplets of moisture may often be seen on dates, especially in the interior of the bunch, early in the morning following a very humid day.

The effect of bags on the occurrence of blacknose in the pollination experiments already described suggested further investigations along this line.

In June, 1930, a number of bunches of Deglet Noor fruit at the Narbonne Ranch were entirely enclosed in large bags, made of brown wrapping paper, similar to that used in the pollination experiments in 1927. The bags were not removed until September 26th. An examination of the fruit showed no blacknose at all on the dates which had been bagged, only a trace of tip checking on a few, while every bunch which had not been bagged on the same palms had more or less blacknose of a pronounced type. In ten experiments at the U. S. Experiment Date Garden in 1931 brown paper bags of the same material also inhibited the occurrence of blacknose checking which occurred on dates not so protected.

However, bagging cannot yet be recommended as a means of preventing blacknose. In these experiments summer bagging tended to decrease the size of the dates and to take away some of the distinctive Deglet Noor flavor. The bags also favored the development of fungi. Analyses made by J. L. Heid, Associate Chemist, Bureau of Chemistry and Soils, Laboratory of Fruit and Vegetable Chemistry, Los Angeles, showed that the total sugar content of dates bagged at the Narbonne Ranch in 1930 was less than the dates not bagged. The total percentage of sugar on a dry basis in two analyses of each was as follows: unbagged dates, 74.0, 74.8; bagged dates, 70.2, 64.8.

The type of bag is also a matter of importance. Paper or other material which has been treated to render it non-porous apparently increases the amount of blacknose checking, due possibly to an accumulation of moisture from transpiration of the dates. This was the result with "Vito-fabric" used in experiments at the U. S. Experiment Date Garden and with commercial "Elastikraft" bags used at the Narbonne Ranch in 1931.

As the latter type of bag is extensively used throughout the Valley to prevent rain damage it seemed worth while to find out whether early bagging would have any effect on the occurrence of blacknose. In a part of the garden where Mr. Gridley thought from previous observations that blacknose would be likely to appear, three or four bunches on each of nine Deglet Noor palms were covered with the "Elastikraft" bags on July 20th, one month earlier than bags were placed on the other bunches according to the usual custom at this ranch. An examination of the fruit on September 19th showed that earlier bagging actually increased the amount of blacknose. An average of 22.7 per cent of the dates bagged on July 20th were badly affected while only 13.9 per cent of those bagged on August 18th were similarly injured. It is proposed to make further tests with different types of coverings and with moisture absorbent materials.

These observations and data indicate that the principal factor involved in the production of the minute, transverse, apical checks which precede and are probably largely responsible for blacknose is humid weather just prior to the time when the date begins to take on the first definite pink tints of the khalal stage Moisture on the surface of the fruit at that time will cause such checking. Most of the Deglet Noor dates in Coachella Valley pass through this susceptible stage between the middle of July and the latter part of August, depending on season and locality. Meteorological records over a period of 54 years show that August in Coachella Valley is the fifth rainiest month of the year. The total amount in a desert region such as this is, of course, very slight, but the month is frequently characterized by local showers, traces of rain, cloudy days and relatively high humidity—conditions which have been found to be closely associated with the occurrence of blacknose.

A Study of Bud Growth in the Date Palm

By D. W. Albert and R. H. Hilgemen, University of Arizona

THE question of bud development and spathe growth was discussed at some length before the date growers by the late Dr. W. R. Faries at the Seventh Annual Institute. Dr. Faries came to the conclusion, after dissecting several palms, that fruit buds for the following year begin to develop when fruit growth for the current year's crop has been completed. He found there were a number of fruit buds each year which did not develop. These undeveloped buds were located in the axils of the leaves immediately above the last fully developed buds of the preceding year. Dr. Faries brought up the question as to whether this group of buds which do not develop could be made to produce fruit or is it necessary to grow more leaves and buds to increase fruit production.

It was this paper that created in us the desire to learn more about bud growth and fruit production.

Early in May, 1931, nine Rhars palms, 28 to 32 years of age, were selected for dissection. Five of the palms were selected from that part of the University Garden having a planting distance representing 120 palms per acre. The other four palms were selected from a section of the same garden having 56 palms per acre. All the palms were apparently equal in vitality and productive ability, except that the four palms from the more widely spaced section were somewhat taller than the others and carried a few more leaves. The palms were dissected during the year on the following dates: May 14, July 25, August 7, September 17, November 2, December 21, February 1, and March 7. One palm remains to be dissected the latter part of April.

In dissecting the palms, the lower leaf bases were removed with an ax until a complete whorl of old leaves was distinguishable. The height from the ground, where complete whorls could be determined, varied from two to four feet. From this point the leaves were removed as nearly as possible in rotation. It was observed that those leaf bases behind which a fruit stem had matured, would have a deep groove where the stem had pressed during growth. The leaf bases having no accompaning fruit stems were smooth. The leaf bases were examined as removed and the presence or absence of fruiting stem recorded.

Before removing the green leaves the palm was cut down. The leaves broke the fall of the palm sufficiently to prevent injury to the succulent heart tissue. The green leaves were then pruned back and the removal of leaf bases continued. Near the head of palm the tissue of the leaf bases becomes more succulent and the fiber completely encircles the caudix or trunk. By carefully removing the leaf bases it was possible to remove the buds intact. Each bud was measured and numbered and placed in killing solution for further study. Dissection continued until the undeveloped fronds measured about half inch in length. This gave an average of some 50 measured buds from each palm. Dividing this number by the average yearly growth, it could be safely said that we were working with the buds which would have produced fruit in 1934 or possibly 1935. On further examination it was estimated that leaves for at least two more years were already formed. Each immature leaf had an accompaning bud, but its removal proved very difficult, even with the aid of a dissecting microscope.

CHART A

Leaf Growth and Spathe Development in Closely and Widely Planted Areas in the University Garden

Year	Palms planted 120 per acre	Palms planted 56 per acre
1932	11111xxxxxxxxxxxxxxxxx	1111xxxxxxxxxxxxxxxx
1931	111xxxxxxxxxxxxxxxxx	11111xxxxxxxxxxxxxxx
1930	11111xxxxxxxxxxxx	1111xxxxxxxxxxxx
1929	111111xxxxxxxxxxxxx	111111xxxxxxxxxxxxxx
1928	111111xxxxxxxx	111111xxxxxxxxxxxxx
1927	111111xxxxxxxxx	111111xxxxxxxxxxxxxxxx
1926	111xxxxx	11111111xxxxxxxxx
1925	1111111111xxxxxxx	11111111xxxxxxxxxxxxxxxxx
1924	111111111xxxxxx	1111111111xxxxxxxx
1923	111111xxxxxxxx	111111xxxxxxxxxxxxxxxxx
1922	11111111111xxxxxxxxx	1111111111111xxxxxxxxxxx
1921	11111111111xxxxxxx	111xxxxxxxxx
1920	11111xxxxx	11111111111111
1919	111xxxxxx	111111111xxxxxxxxx
1918	11111111111111	111111111xxxxxxxxxxxxx
1917	1111111xxxxxxxxx	1111111111xxxxxxxxxx
1916	11111111111111	11111111111xxxxxxxxxxxxxxxxx
1915	111111xxxxxxxxx	1111111111111111xxxxxx
1914	11111111111111	111111111111
1913	111111111111111	1111111111111xxx
1912	11111xxxxxxx	11111111111111xxxxxxxx
1911	111111111111	1111111111111111111
1910	111111111111	11111111111111xxxxxxxxxxxxxx
1909	111xxxxxxxxx	111111111111xxxxxxxx
1908	1111111111	1111111111xxxxxx

As previously pointed out by Dr. Faries and observed in this study, the buds which developed into fruiting clusters were in all cases continuous and preceded by the undeveloped buds for that particular year. By noting the break between fruiting stems and undeveloped buds, the different years growth could be ascertained in most cases without difficulty. The most trouble was encountered during those years when no fruit stems were produced. In such cases the break between years was set arbitrarily. Only three cases were observed where all the buds developed flower clusters for a given year. This happened on three palms in the 1931 crop year. Garden records for the year 1930, show these palms were not pollenated and all fruit stems were cut during the month of May. It is doubtful if such a condition would exist where

palms are producing heavily each year.

Table I, shows leaf growth and spathe development for six palms in the closely and widely planted areas of the garden.

TABLE I

Leaf Growth and Spathe Development in Wide and Close Plantings

Date Dissected	Palms per Acre	Years Observed	% Buds Developed	% Buds Dead	Average No. Leaves per Year	Average No. Fruit Clusters per Year
Sept. 17	120	25	39.60	60.40	13.64	5.40
Nov. 2	120	21	41.15	58.85	13.62	5.62
Dec. 21	120	25	45.25	54.75	14.76	6.68
Mar. 7	56	25	59.30	40.70	15.30	9.80
Aug. 6*	56	25	53.16	43.38	18.90	10.04
Feb. 1	56	25	53.95	46.05	18.76	10.12

*This palm had a number of buds which could not be definitely classified

From the above table a wide difference is apparent in fruit production, leaf growth and percentage of buds developed.

TABLE II

Bud Growth 1932-1933

Bud Number

Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sept. 17	0	0	1.25	1.20	1.22	1.32	1.10	1.25	1.15	1.05	1.00	.98	.91	.75
Nov. 2	0	0	2.20	2.85	2.70	2.80	2.60	2.50	2.30	2.50	2.65	2.50	2.60	2.40
Dec. 21	0	0	0	0	0	4.85	5.70	6.20	5.85	6.35	6.40	6.35	6.70	7.00

Bud Number

	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Sept. 17	.74	.59	.50	.55	.51	.40	.40	.40	.40	.40	.38	.28	.30	.30
Nov. 2	2.35	.90	.68	.58	.58		.51	.50	.50	.34	.41	.31	.31	.30
Dec. 21	7.30	7.45	7.60	8.90	8.70	9.95	10.15	10.35	10.00	.95	.85	.80	.70	.60

Measurements refer to length in centimeters

Table II, gives a graphic picture of the buds as they were found on September 17, November 2, and December 21. It is interesting to note that the buds on September 17 became uniformly smaller as they approach the terminal bud. There is no apparent difference in rate of growth between 1932 and 1933 fruit buds. This same condition was found in all palms dissected prior to September 17. On November 2 the first indication occurred whereby the buds belonging to the 1932 crop could be segregated. Buds numbering 3 to 15 inclusive are nearly the same size. This indicates that bud growth has been accelerated in the upper group of buds in the 1932 crop. Buds numbering 16 to 55 appear to be growing at the same rate as before. The December 21 measurements are strikingly different. The upper group of buds have increased in size to such an extent that the size range is directly inverse to buds as found on September 17. The 1932 fruit buds increase in size as they approach the terminal bud. Buds number 24 to 55 continue the same relative growth, getting smaller as they approach the terminal bud.

Table III, shows bud growth over a ten-months period. The average growth of the first three live buds and last three live buds of the 1932 crop were taken for rate of growth comparisons. In dissections prior to November 2, buds number 5, 6, 7 of the lower group and 18, 19, 20 of the upper group were arbitrarily taken for a basis of comparison.

TABLE III

Bud Growth for Lower and Upper Buds of 1932 Flowering Cycle

	May 14	June 25	Aug. 6	Sept. 17	Nov. 2	Dec. 21	Feb. 1	Mar. 7
First 3 buds	.52	1.64	1.14	1.21	2.58	5.58	8.82	27.43
Last 3 buds	.23	.31	.44	.49	2.45	10.17	20.30	97.43
Average for all buds	.41	.52	.76	.85	2.53	7.54	15.04	60.83

(Measurements in centimeters)

Dissections made on May 14 and June 25 showed all buds alive and making some growth. On August 6, all the buds were found alive, but the lower group of buds had made a more rapid growth than the upper buds. The first undeveloped buds were found September 17, the first two buds having turned brown and died sometime between August 6 and September 17. The growth for both the lower and upper buds was less than for the preceding period. The November 2 dissection also showed buds number 1 and 2 had died some time previous. Marked growth occurred in both upper and lower groups of buds. Between November 2 and December 21, a very rapid growth occurred particularly in the upper group of buds. During the first part of this period the growth curves for the lower and upper buds crossed. February 1 and March 7 dissections showed the upper group of buds continuing to grow at a more rapid rate than the lower buds. The average growth increased rapidly from an average for all buds of the 1932 crop from 2.53 cm. November 2 to 7.54 cm. December 21; to 15.04 cm. February 1; and to 60.83 cm. March 7. On March 7, the uppermost spathe was showing 8-10 inches above the fiber.

To summarize briefly, it would appear from these data that bud growth is continuous throughout the year. Bud differentiation probably occurs early in the summer sometime before the buds start rapid growth and perhaps prior to August 6. The buds in the upper end of the flowering cycle develop later but are more active and make a more rapid growth than lower buds of the same cycle. Their respective growth curves cross about the first of November. It would appear that fruit bud growth is directly tied up with nutrition of the palm, rather than with the total number of leaves produced.

Microscopic examination of the buds will be made to attempt to determine the exact time of differentiation. It is possible that all the buds for one season's crop do not differentiate at one time but that differentiation occurs over a more or less extended period. This may have some bearing on the "off-bloom" retarded blooming of some palms.

To further study the factor of nutrition on the development of the buds, an experiment has been started at the Tempe Station. Four Rhars palms have been selected, two of which are to be fertilized heavily for two years. At that time the palms will be dissected to determine the effect of this treatment upon development as related to undeveloped buds and total leaf growth.

Date Culture in Tunisia--Miscellaneous Observations Elsewhere in the Mediterranean

By Robert W. Hodgson, University of California

A RECENT leave of absence of slightly more than a year, spent in horticultural studies in various parts of the Mediterranean basin, provided the opportunity to see something of the date industry in the French protectorate of Tunisia and to make a few miscellaneous observations on its culture in certain other countries. It was especially gratifying to be able to study the industry in Tunisia, owing to the fact that the Deglet Noor is one of the leading varieties there and that this ancient country comprises one of the sources of introduction of this variety into the United States, and also the source of many others. It is a pleasure indeed to report that Kearney's publication* summarizing his observations in Tunisia and describing a large number of varieties, now long since out of print, is still remarkably accurate in nearly all respects and that the French translation published a few years later** is today the handbook used by the Government officials and growers. Indeed there is only one other general publication on the date industry in Tunisia worthy of mention, that of Masselot,*** of which I had the great pleasure of reading the original hand-written manuscript, prepared several years before its publication. It is also a pleasure to report that it was my good fortune to meet both French officials and natives who assisted Kearney in his work, and that all were lavish in their praise and interested to learn of the outcome of his efforts. Quite generally they were astonished at my report of the commercial development of Deglet Noor culture in California and to see the carton of fancy fruit I had taken with me. While much of what I shall report is undoubtedly better described in Kearney's bulletin, the fact that it is no longer available, as well as differences in viewpoint, may render the repetition permissable.

*Date Varieties and Date Culture in Tunis, by T. H. Kearney. Bulletin 92, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1906.

**Le Dattier en Tunisie — Culture, Varieties d'apres Date Varieties and Date Culture in Tunis par T. H. Kearney, Traduit et remanie' par J. Simonot. Bulletin de la Direction de l'Agriculture, du Commerce, et de la Colonization. Tunis, 1910.

***Les Dattiers des Oasis du Djerid par F. Masselot. Bulletin de la Direction de l'Agriculture et du Commerce. No. 19, 1901, Tunis.

Physiography, Geography and Climatology of Date-Growing Regions

The date is grown commercially in Tunisia in three physiographical regions which, listed in the order of their importance, are as follows:

(1) The basin of the Djerid. This is a great, irregularly shaped, enclosed basin in the extreme south, which comprises a portion of the northern Sahara desert. The basin itself, the lowest portions of which are only slightly above sea level, consists of three main parts each of which is occupied by a salt lake. These lakes or chotts, as they are called, are usually practically devoid of standing water during the dry months, though portions of them are always wet and very treacherous. In early spring they are often submerged to depths of several feet and hence impassable. The passage of the Great Chott Djerid from Kebili to Tozeur involves the traversing of some 25 miles of apparently endless snow-white expanses of salt crystals and is both an interesting and novel experience.

The largest and most important of the three sub-basins, and also the lowest, is that occupied by the Chott Djerid, to which reference has just been made. To the north of this basin and separated from it by a low, narrow ridge on the west and a long, slender range of mountains on the east is the basin of El Rharsa, the lower (western) end of which is occupied by the Chott of the same name. The third and least important sub-basin, occupied by the Chott-el-Fedjadj is a long narrow, almost separated arm of the Chott Djerid extending eastward between converging mountain ranges, almost to the seacoast at Gabes.

The principal oases of the basis of the Djerid-Nefta, Togeur, and El Oudiane, lie on the southern slope of the ridge separating Chott Djerid from Chott-el-Rharsa and on the southern and western slopes of the peninsula separating Chott Djerid and Chott-el-Fedjadj-Kebili, Mannsoura, Debabcha, etc. This region is generally referred to as the Nefzaoua. El Hamma du Djerid, to the north of Tozeur, is situated on the northern slope of the ridge between Chotts Djerid and El Rharsa, while El Hamma proper lies at the extreme eastern end of the basin of Chott-el-Fedjadj, not far from the seacoast oasis of Gabes. Tamerza and Gafsa are important oases of much higher elevation lying at the base of the mountains which form the northern boundary of the basin of Chott-el-Rharsa.

Climatically the Nefzaoua-Kebili, etc., is the region of greatest heat and aridity and, as one might expect, here the Deglet is of superlative quality. Only slightly less hot and arid are the oases of Nefta, Tozeur and El Oudiane and here also the Deglet is excellent. At El Hamma, however, the heat is decidedly lower and the humidity higher and the Deglet is not commercially successful. And at Tamerza and Gafsa, while the heat is intense at times, and the humidity not appreciably different from Tozeur and Nefta, the higher elevation results in insufficient heat for the Deglet.

(2) The extreme southern coastal plain. This region consists of the narrow coastal plain extending from the vicinity of Gabes south and eastward to the Tripolitanean frontier, including the Island of Djerba—the ancient land of the lotus eaters. The principal oases are Gabes and the group surrounding it (Teboulbou, Methouia, Oudref, Aouinet, etc.), Zarzis, at the extreme southern end, the oases of Djerba, and Maret and Ketena. These oases are all situated either directly on the seashore or not far inland and hence are subject to the tempering influence of sea breezes and relatively high atmospheric humidity. As a consequence the Deglet is a complete failure and the quality of the dates in general quite low.

Extending northward along the coast from south of Sfax almost to Sousse there occur a number of fairly large groups of palms—at Mahares, Malhidia, Monastir and Sahline—but owing to the lower heat and high humidity fruits rarely ripen and the trees are utilized for other products. This region is commonly referred to as the Sahel.

(3) The mountainous desert area. Lying between the Nefzaou and the coastal plain is a region of low, barren highly eroded mountains where the date is cultivated up to elevations of 1500 to 1800 feet. While the total production is relatively small, the date is of great importance to the native population in this region and the system of culture employed of special interest, as will be brought out later. This is a region of tremendous climatic extremes—cold in the winter and hot in the summer, with very great fluctuation between day and night temperatures. The principal oases are Medenine and Metameur, though dates are grown quite generally from Foum-Tatahouine in the south to Matmata on the north. This region is usually referred to as the Matmata.

History and Present Status of the Industry

That the date was grown in the oases of southern Tunisia prior to the period of Roman occupation, which followed the fall of Carthage, is evident from the writings of Pliny and others. Thus Pliny refers to the numerous palms and the system of inter-calary culture beneath them—as it exists today—at Tacape, now the oasis of Gabes. The philologists find evidence to support the belief that the desert population of that period was of mixed Phoenician, Ethiopian and Berber origin from which it is assumed that the date was brought there at a very early period, either from Egypt or Ethiopia. At any rate, when the Romans extended their frontiers to Lake Triton,—thought to be Chott Djerid—they found in the oases there a thriving civilization in which date culture held an important place, and established numerous outposts, some of which were situated at the native cities and named after them. Among these were Thuzurus — now Tozeur, Aggarsel Nepte—now Nefta, Ad Turres—Tamerza, Mades—Mides, Tacape —Gabes, etc. The remains of the Roman military road from Ad Piscinam—Biskra (Algeria) — to Gabes still exists as do also the remnants of the Roman causeway uniting the Island of Djerba to the mainland, and also the ruins of dams in the oases of Gabes and El Oudiane. In the Roman period, however, the date does not seem to have occupied the relative importance that it does today, for there are numerous references to the culture of the olive and pistache and to vegetable growing in the oases.

Following the fall of the Romans the Vandals and the Byzantines successively established their control over the flourishing oases, only to succumb eventually to the westward surging wave of invading Arabs who in 647 A. D. first conquered the basin of the Djerid. For a half century or more this control was more or less successfully disputed but about 700 A. D. the Arabs definitely established their supremacy and the oases remained under Arab domination until 1881 when the French finally established their suzerainty in the form of a protectorate.

During the thousand and more years of Arab occupation the industry gradually assumed the form which, for the most part, exists at present and has been so well described by Kearney. In those oases where the date was best adapted it gradually assumed a position of paramount importance and displaced other fruits, excepting as these were grown as intercalery plants for local needs only. In the other oases greater emphasis was given to fruits or crops better adapted to the conditions. Thus the oasis of Gafsa is now largely devoted to the olive, apricot and pomegranite and is especially famous for the two latter. And the seacoast oases have remained centers of production of the olive and pomegranite and vegetable and field crops of various kinds, including henna, which is much used by the natives. New oases were created as water supplies were found and the water supplies of some of the old oases were augmented by tunneling into the underground drainage.

It was during this period that there was finally achieved the remarkable systems of water rights and measurement of which the most famous is that at Toxeur credited to the Arab sage, Ibn Chabbath, who died in 1282. Much more recently came the discovery and introduction of the Deglet Noor variety, the latter credited to Sidi Tonati of Tozeur about 1600, the gradual spread of which was the chief factor in the development of export trade with Europe.

During the half century of French occupation many notable improvements have taken place, impossible of attainment so long as a national government existed so weak as to be unable to afford protection and security of life and property to the dwellers of the oases. The pacification incident to French control has permitted the natives to expend their energies in peaceful pursuits and as a consequence there has been a decided growth and stabilization of the industry. Scores of artesian wells have been bored, increasing water supply materially and making possible the further extension of old oases and the creation of new. And control measures against certain insects and diseases have been instituted. But perhaps most important of all, the existing water rights,—passed down by word of mouth from generation to generation—have been codified, adjudicated where necessary, and legalized.*

Statistics on the Tunisian date industry are highly contradictory and the methods by which they are obtained are not conducive to accuracy. The general source for statistical information is the tax list prepared by the native officers — the caids and califas — to whom the responsibility for the collection of the taxes is delegated. Only bearing palms are assessed, as I recall it, and the rate varies for the principal varieties and groups of varieties. There is much opportunity for dispute and for connivery to evade the payment of taxes. As a consequence it is virtually certain that the actual number of bearing palms is much larger than reported and that the total number of palms is a mere guess. According to the last official statistics available (1930) the total number of palms was 2,650,000 of which 1,225,000 were classed as bearing. The largest crop during the past decade is said to have been 91,300,000 pounds, or an average yield of approximately 75 pounds per palm. My observations would indicate that this yield is high, from which my conclusion is that the number of bearing palms is greater than this figure. The total number of Deglet Noor palms reported is 115,000 of which 70,000 are classed as bearing, with a maximum crop to date of 4,180,000 pounds, or approximately 60 pounds per tree. The yield fluctuates greatly from season to season according to the favorableness of conditions. The best estimates available indicate an oasis acreage of approximately 18,000 de-

*See the excellent reference—L'Hydraulique Agricole Dons La Tunisie Meridionale par P. Penet, Tunis, 1913.

voted to dates, or an average of about 140 trees per acre.

The great bulk of the plantings, gardens as they are called, is held in the ownership of a comparatively few wealthy Arabs — not to exceed several hundred in all—and practically all of them are operated by caretakers who work on the share basis. Very little money actually changes hands, payment for services being made in the form of a portion of the crop. The system of payment for the different classes of services is highly interesting and complicated. Some of the French owners also operate on this basis, though the larger development projects, of which there are a number—at Kebili, Tozeur, El Hamma du Djerid, Aouinet, De Lesseps, etc.—operate on a cash basis, with superintendents or managers, foreman and hired labor.

Like all Arab gardens, the date plantings are characteristically enclosed with walls, usually of earth, and surmounted with palm leaves, and separated by roads or lanes which by division become narrower and narrower until finally they will accommodate only the pedestrian and ubiquitous donkey. The plantings themselves are for the most part dense jungles of palms of all ages, sizes and varieties planted without reference to alignment, interspersed between and under which are vines and fruit trees of all kinds, principal among which are the apricot, pomegranite, fig, orange and lemon, banana and peach. The soil is laid up in basins of various sizes, though usually rectangular in shape, some of which are planted to vegetables and forage crops — cereals and alfalfa. Irrigation and drainage ditches cross and recross the gardens and roadways, the former often over the latter in palm trunk flumes and the latter under palm trunk bridges, forming a highly complicated network.

In the newer plantings, both Arab and French, the trees are planted in rows 8 to 10 metres apart, usually in permanent basins, with broad flat ridges in alternate middles, providing an appearance much like that of some of our California plantings.

Some of the trees in the old native gardens are very tall and undoubtedly very old—some were said to be 200 years or more of age. In general, however, it appears that after attaining an age of 60 years or thereabouts the palms decline rapidly and are soon cut down for the manufacture of crude lumber.

In the desert the palm is all-important to the native and is said to be an object of veneration. Of the latter I must say that I did not observe any particular evidence. Every part of the tree is utilized in one or more ways, however, and nothing is allowed to go to waste but the seeds. The high quality fruit is sold to provide what money may be required for the purchase of imported articles—sugar, tea, coffee, tobacco, etc. The next lower quality is used to exchange for needed articles of native fabrication. And the poorer qualities are used for food for both man and beast. The leaves find innumerable uses—weaving of baskets, mats, etc., construction of fences, manufacture of crates, etc. Even the thorns are used. The trunks are converted into rough lumber used for a variety of purposes. And a sweetish liquid, lagmi as it is called, extracted from the head of the palm provides a refreshing drink when cool and fresh and a strong intoxicant when fermented.

Water Supply and Soils

The major water supply, and in some of the most important oases, the only source, is springs. These apparently arise from one or possibly more deep artesian strata, which extend from east to west clear across the northern Sahara from Morocco to Tunisia, evidently supplies by the Atlas mountains to the north. These springs vary enormously in size and rate of flow, some of them comprising small rivers which in ages past either lost themselves in the desert sands or discharged their contents into salt flats or the sea—in the case of the oasis of Gabes. In the great majority of cases the original river beds have long since disappeared, their place having been taken by the systems of canals which distributes the water over the oases. In order to increase the water supply, at the edges of many of the oases long series of shallow tunnels have been dug, some a half mile or more in length, to tap hidden springs or catch underground drainage. Some of these tunnels represent an enormous amount of work and the method is probably of Roman origin. It is also customary to dig shallow wells on the slopes flanking the oases, where the water table is within reach, and to raise water by hand for the irrigation of terraces too high to be irrigated by gravity.

As previously mentioned, the boring of deep artesian wells has been practiced to some extent by the French and this has materially increased the water supply in some of the oases. It has also made possible the creation of new oases, especially in the Nefzaoua and to the north of Gabes, thus appreciably expanding the date acreage.

Protection of the springs and wells against the invading sand is in most oases an important problem. Palm leaf fences to hold the ever advancing sand, windbreaks — usually of athel—and other devices, serve only as temporary expedients and it is frequently necessary to dig out the springs and haul away the sand. An annual cleanup of all the springs is customary in most of the oases in addition to the work that unusually severe sandstorms may necessitate.

In a few of the oases the palms are grown without irrigation, the water table evidently being near enough to supply the roots. Under these conditions, however, both the yield and quality of the fruit are usually poor. In the mountainous Matmata region, where the rainfall is but 6 to 8 inches, dates are grown commercially without any irrigation save that provided by the impounding of the winter run-off waters. By means of converging systems of low dykes, as much of the run-off waters as possible is conveyed on to bordered terraces or into shallow basins, which are occupied by olive and palm trees. Every narrow valley is provided with a series of ascending terraces and every knoll with its basins, and practically every spot where trees can be planted and water conveyed to them is utilized. Both the yield and the quality are poor but this system of culture is of great importance.

Most of the spring and well waters are warm, some even hot, and they are all moderately to highly salty. In some of the oases the content of the water reaches five to six thousand parts per million of soluble salts.

The excessive concentration of salts is prevented to a very considerable degree by the use of open ditch drainage, the importance of which is quite generally appreciated. In some of the more recent plantings tile or rock drains lead from each tree to drainage ditches or tile drains closely and in one case at least—at Tozeur—a highly salty tract is being reclaimed and developed at the same time by means of a drainage system and leaching with drainage water from the oasis, the drainage water itself being quite salty. In spite of all that can be done, however, there is considerable salt in the soil, though the concentration does not appear to be injurious to most crops.

In most of the oases the water from the several springs—often numerous — is all brought together in one main canal—the entire water supply for the oasis. It is then separated into a number of streams—each supplying a certain number of gardens—in accordance with the rights handed down from past generations. The division is now usually effected by concrete weirs with the proper openings. It was formerly done by means of weirs constructed of palm trunks with sawed openings of the proper lengths. Each garden owner, in accordance with his rights, receives the full flow of the ditch serving his garden for a certain period—once a week—usually, sometimes less often. The system is a highly ingenious one whereby the flow is constantly in use, day and night, with no loss of time or water. Every garden operator knows his time and period of flow as well as that of his neighbors and is ready when his time comes.

The soils in the oases are either alluvial or aeolian in origin — often a combination of the two. For the most part they are fine in texture and deep-silt loams or silty clay loams. Near the salt flats they are sometimes underlain with salt impregnated layers but for the most part in their natural state the salt content appears to be low. In the oases of the coastal plain sub-surface layers of high gypsum content are frequently found. In their natural state the organic matter content is of course very low, but the cultivated soils of the oases appear to have a fairly high content of organic matter.

The Varietal Situation

Unfortunately my stay in Tunisia—December to September — did not cover the major part of the fruit season and hence I was not able to observe the early ripening varieties. Owing to its high dessert quality and ease of preservation the Deglet Noor is by far the most valuable variety, though, as indicated above, it is by no means the most important even in the basis of the Djerid, where climatic conditions favor its culture. The high price it commands, however — three or four times that of any other variety—serves as a strong incentive to plant this variety and as a consequence it is the only variety now planted in quantity. Second in commercial value, and highly esteemed by the natives, is the Ftimi variety, a medium-large, late ripening fruit of which the trees are vigorous and productive. The Menakher variety, one of the largest fruited sorts and of excellent quality, is gradually increasing in importance though the number of trees is still small. Until the French occupied the Protectorate there was no incentive whatever for propagating this variety as the crop was invariably commandeered by the Bey in lieu of the payment of taxes.

In all probability the two most important varieties are the Horra and Kenta, which, though of inferior quality, are extensively grown in all the oases. The actual number of varieties is very large—more than 100 named sorts and many with no specific designation—but at present only a few are propagated and planted commercially. They are all grouped into the two classes—soft and dry. Most of the former are preserved with difficulty; the latter comprise an important food supply throughout the year and are exported in large quantity to Tripolitania, Algeria, and the southern Sahara.

Owing to their climatic requirements the high quality dates are all grown in the oases of the Djerid. The dates of the cooler oases and of the coastal belt are practically all of inferior eating and keeping quality and suitable only for native use.

Propagation, Planting and Spacing

The use of relatively small offshoots appears to be the general practice and no mention was heard of any special difficulties in their removal and planting. The offshoots are pruned back rather severely before removal and are protected with palm-leaf shades until they are well established. They are irrigated frequently—on the average once a week or oftener.

They are planted in large holes in sunken basins very much as we do it. Where new gardens are being established it is customary to work the soil thoroughly and very deeply —often as much as 40 inches—by hand, which is done by means of the native hoe (Messah). This is accomplished by digging a trench along the edge of the area to be planted and moving the trench across the area in question. It is slow and laborious effort, though not so expensive as one might think, but they are convinced that it is important. The price of offshoots is very low—35 to 50 cents for good Deglet Noor offshoots and less for other varieties.

In the old gardens the palms are closely spaced — much closer than ours—but in the newer gardens the spacing is about the same as that we employ—26 to 32 feet.

Cultural Practices

Irrigation is practiced by the basin method, the basins varying in size from small to large. The frequency of irrigation varies somewhat but the usual interval is one week, though some gardens receive water only every other week. The depth of the basins and frequency of irrigation suggest the probability of excessive use of water and this is indicated by the importance attached to drainage as well as the actual amount of water in the drainage channels. This may be necessary, however, owing to the salt content of the water itself. It would appear, nevertheless, that there is considerable waste of water.

Manure is the principal fertilizer applied and its use is general in most of the oases and especially on trees of good varieties. It is commonly applied in the basins and hoed in, though some of the growers mix it with the soil used in mounding the trunks of the palms. The practice of mounding is employed by many of the better growers, both native and European, and several of them stated that once instituted it is advisable to continue the practice owing to the reduction in root feeding surface which follows its abandonment. A few of the growers are now applying commercial fertilizers, either in the basins or mixed with the soil in the mounds.

Pollination is practiced much as we do it and is commonly done by small boys who sing lustily as they work, or carry on an animated conversation with one or more friends in trees in neighboring gardens. The superiority of certain male trees as pollen sources is generally recognized. There is no thinning of the blossom strands at the time of pollination or of the fruit afterward. The fruit clusters—rarely as heavy as ours—are often supported, if the stems are long enough, by hanging them over a neighboring leaf.

The trees are commonly pruned much more severely than is our custom. As soon as a leaf begins to hang low—sometimes even before—it is removed, for some use is already awaiting it. In any event the leaves are removed long before they have lost their usefulness, to the tree.

Cultivation is frequent and often deep and, like all other soil stirring operations, is done by means of a heavy, short handled hoe.

Harvesting and Preparation for Market

Most of the crop is now sold in bulk immediately after harvesting

though formerly it was the general practice for the buyers to purchase the crop on the trees. Bunch picking is the universal practice and with varieties of inferior quality the bunches are cut and dropped to the ground and the fruit gathered up and pulled from the strings and placed in suitable containers—boxes, baskets, skins, etc. In harvesting fancy varieties such as the Deglet, Menakher, and often the Ftimi, a human chain is formed along the palm trunk and the bunches passed down from hand to hand to the ground where they are carried to a convenient place for cutting the strings of dates from the bunch stem, andw here they are sorted and bulk packed in wooden cases. The harvesting is both a horticultural and ceremonial operation and is accompanied by chanting.

A considerable part of the Deglet crop is shipped to Tunis for re-sorting and packing in smaller cases or cartons for export to Europe, though some of it is shipped direct to Marseilles, the most important date processing and packing center for North African dates. I was told that some of the packing plants in Marseilles are equipped with vacuum fumigators and that it is the common practice to recondition the poorer quality fruit by immersing it in a dilute fruit sugar syrup. To judge from the fruit, I saw in the markets of Europe, however, some very attractive packs are made. For the fancy packs it is customary to leave the fruit attached to the fruit strings.

I visited a number of the principal packing plants in Tunis and, while some high quality packs are turned out, there is still room for vast improvement in handling methods. Between harvesting and packing there is often a period of several months during which the dates remain in the cases in which they were packed in the field. No effort whatever is made to control the storage conditions or to prevent infestation with insects. As a consequence a very considerable part of the fruit is either fermented or insect-infested, or both, by the time they are ready to pack it. Both the packers and growers firmly believe that the fruit becomes infested with insects while still on the trees, and this may be true to some extent, though I saw no evidence of it. I examined quite a lot of fruit direct from the trees and did not succeed in finding a wormy one, yet in the storage rooms some of the lots I examined showed as high as 50 per cent worm infestation. Moreover, I took a lot of 400 dates directly from a tree and exposed them in a hotel room in Tunis for more than four months along side of an open 3-pound box of California Deglets, which had been fumigated and were known to be free from insects. Not a single wormy date resulted. The principal insect I observed in the storage rooms appeared to be the common dried fruit beetle.

The fermented and insect-infested fruit is not a total loss, however, for it is mixed and made up into a paste which is sold locally.

When the fruit is removed from the cases for packing it is sorted into various grades — wormy, fermented, soft, dry, etc.—and the better fruit is then separated into two or three quality grades. The fruits are then cleaned and polished by rolling between the hands and packed in cartons or small wooden cases. The soft dates are commonly seeded and stuffed with pistachio nut paste and rolled in flower or powdered sugar. The dryer fruit is commonly sold in bulk for the grocery, hotel, and restaurant trade. While some of the packs are highly attractive and the quality of much of the fruit very good, one is never certain that he will not find a wormy or sour date and one soon learns to cut all dates open and examine and smell them before eating them.

Insects and Diseases

So far as the trees are concerned the Parlatoria scale is regarded as the most important insect pest, though it appears to be bad only on young, vigorous growing palms. Some of the French growers, and a few of the native, have obtained fair results in its control by spraying with engine oil emulsion. I was told that the Mediterranean fruit fly sometimes attacks the fruit but I saw no evidence of this and am inclined to doubt it.

Of diseases the two most important I saw were the flower cluster rot (Khamedj) and the drooping heart (le coeur qui penche) though neither of these appeared to affect more than a very small percentage of the palms. The former injures or destroys the flower clusters before they open and is combatted by a combination of pruning out the infected clusters and dusting with Bordeaux powder. The latter resembles very much our so-called fool disease,* where the terminal bud grows in a lateral direction and the palm declines. I saw also several types of leaf spots and blotches, some of which resembled those common in California. Typical leaf notch and abortive offshoots were also seen and also the severe trunk splitting which seems to accompany the decline of many of the old palm trees.

Major Problems and Desirable Improvements

In my opinion, among the major problems confronting the Tunisian date industry and the desirable improvements which should be made, the following are of outstanding importance:

(1) The finding of better varieties for the coastal oases and those of higher elevation and lower heat in the interior. The introduction and testing of Egyptian and Persian Gulf varieties appears to be highly desirable.

(2) The employment of early harvesting and artificial maturation for the improvement of quality and reduction of losses in the cases above mentioned.

(3) The elimination of inferior varieties in all the oases, but especially those of the interior.

(4) The adoption of more careful methods of harvesting and bulk packing of the high quality varieties.

(5) The installation of suitable equipment and the adoption of proper methods for controlling insect infestation of the fruit and the prevention of fermentation.

Possibilities and Outlook for the Industry

In my opinion the possibilities for the improvement and further expansion of the industry are considerable and its economic outlook favorable. With planned and directed effort, such as the French are employing in the solution of its problems, the probability is strong that date culture will become an increasingly important horticultural industry in the Protectorate and will successfully meet its only competition—that from Algeria.

Miscellaneous Observations Elsewhere

I saw very little of date culture elsewhere in the Mediterranean basin but the following miscellaneous observations may be of some interest:

I was much impressed with the size of the fruits and early ripening of the Hayany and Zagloul varieties in the delta of the Nile and with the evidence of the adaptation of these varieties to the seacoast climate of the lower delta region.

I was also impressed with the pos-

*For an up-to-date discussion of diseases of the date palm, see the excellent publication, "Diseases of the Date Palm, Phoenix Dactylifera," by H. S. Fawcett and L. J. Klotz, Bulletin 522, California Agricultural Experiment Station, March, 1932.

sibilities for date culture which apparently exist in the lower Jordan valley of Palestine. Some dates of fair quality were seen, produced at Jericho.

The large size and good quality of the Bou-Fouggous at Marrakech, Morocco, were also impressive. As to whether this is the same variety as the Bou-Fagous of Tunisia I am unable to say, but the description of the latter given by Kearney would suggest the probability that the two are different.

Report of Progress: Date Scale Eradication

By B. L. Boyden, Senior Entomologist, U. S. Plant Quarantine and Control Administration, Indio, California

WHEN the first date palms were brought into this country they carried with them the Parlatoria scale which was early recognized as a serious pest. A campaign of eradication was carried on against the scale and by 1926 it seemed well under control. In the fall of 1927, however, outbreaks of the pest occurred in both Arizona and California and additional funds were voted by Congress to make a survey of the date growing area to determine whether or not eradication were feasible.

In 1928 a rapid survey of the entire date growing area was made to locate heavy infestations and get an idea of the number of date palms and description and location of the plantings.

From the history of the past work on the Parlatoria scale and general information concerning similar scale insects, together with the information obtained by the survey, eradication seemed possible and feasible. A report of the findings together with a plan of procedure and estimated costs was presented at a meeting of representatives of the agricultural departments of California and Arizona, and the growers. The program was adopted and a reorganization of the work begun early in 1929 when an emergency appropriation by the State of California was made available.

The eradication program is based on the fact that by careful inspection infested palms can be located and treated before the infestation develops to a point where there is a spread to nearby palms. It had been proved that scale on the individual palm could be eradicated by the treatment then in use.

It was found that there were thousands of palms in abandoned seedling gardens or unthinned nursery rows which could not be inspected properly. Approximately 65,000 of these have been dug out with permission of the owners and many more pruned up so that inspection is effective. We have a few more palms which the inspectors will dig out some time when wind interferes with inspection. Very few palms remain which cannot be inspected properly.

We consider the possible distance of spread by natural means from a severe infestation about two miles. All the territory within a two mile radius of severe infestations is considered the infested area. The scale is a very small insect and light infestations are sometimes overlooked. It is necessary, therefore, to inspect the infested area carefully and frequently. We also believe that this systematic inspection should continue over a period of about three years. In infested gardens we believe two years of careful inspection should be continued after the last scale is found. This should clean up all the leaf infestations. There remains the possibility of infestation behind the leaf bases on larger palms. As we have recorded the location of all infested palms, careful leaf-base inspection should disclose such infestations if present.

Another essential part of the eradication work is to locate all palms in the date growing areas. A very large percent of the palms were located and listed during the first survey. As inspection continued other palms were located. Finally a section-by-section survey was begun to locate unlisted palms. The infested area has been covered and the remainder of the irrigated portion of the Valley will be completed this year.

While we have made some general statements concerning the time which must elapse after the last scale is found before a district is considered free from scale, there are many factors which may influence the time and each property will be considered separately after careful study of its history. When we are satisfied that a certain property is free from scale and there is no danger of further spread it will be removed from our inspection lists.

We believe that we are nearing the end of the project and many properties have received their final inspection. We are not through, however, and any let-up at this time may prove disastrous.

Marketing Problems

By Edwin Humason, Sales Manager, Calavo Growers of California

IF I may be permitted, I would like to leave a few remarks with you regarding the spirit of cooperative marketing. That is the important point. Almost any specialty crop and a good many staple crops can be sold through cooperative marketing.

I heard a few very excellent thoughts and I have one or two to leave you. The first is that in the history of cooperative marketing, we find a long line of failure. Failure was primarily due to the fact that growers expected the product to cooperate. That does not happen. Human beings necessarily have to do the cooperating. The products will then take care of themselves. With this thought in mind, there is only one principle — that is confidence. The growers must have confidence in their board of directors and in their general manager. If they have this confidence, and if the right man is selected, a good percentage of the troubles are over, provided that the spirit of cooperative marketing is being applied to a product that lends itself to the process.

It is rather difficult to form a co-

operative marketing association for wheat, corn, oats, etc. They are raised all over the world.

Oranges, grapefruit, walnuts, and other California products cannot be raised all over the world. This is one reason why cooperative marketing is successful in California. With our own fruit, avocados, we have competition from Cuba.

Of all things that human beings eat, I can think of none, at the present time, that lends itself to the principles of cooperative marketing any better than your own. I have been told that your only competition is importation. True, raising on low priced lands, low taxes, low labor rates furnishes competition, but you have the possibility that Congress would protect you at least to a limited extent through tariff, if you do not already enjoy one. It seems to me that the date industry in California has a particularly bright future, if it is properly guided.

Because the avocado industry is not as favorable as your own from a marketing viewpoint, because it can be raised in other parts of the country, and because we have a slightly more difficult sales problem, because our fruit is picked firm and must go through a period to arrive at the ripe stage, like bananas, we have had a greater problem than your own. Our crop this year is about eleven times the tonnage of two years ago. The crop next year is going to double. In five years from now, it will be still much larger. We are not primarily concerned, because of the per capita consumption. The human being eats three times a day. So much food goes into your stomach every day.

As I said, potato growers cannot have a cooperative association because potatoes are raised all over the country. The same thing is true of sweet potatoes, lettuce—surely it is true of grains. Some of these industries are having a rather trying time now because of the fact that cooperative associations are trying to put other products into the human being than potatoes, bread, etc.

The changing habits of people are largely traceable to the successful operations of cooperatives, who have advertised. The second previous speaker mentioned the effect of advertising for orange juice. It is surprising to note the increase in the amount of advertising done about food articles. A few years ago there was little advertising of food done. Every sale we have made has been the direct result of sales promotion. We sell ideas through advertising. We show them how to serve a calavo, we teach them how to handle it, give them a taste of it, then they buy it. So far they have bought it at a price satisfactory to growers.

The mere fact that our growers are still in operation shows that prices were satisfactory. They have not been satisfactory every time. Miracles cannot be performed. Growers are sometimes disappointed, after buying land on the promise of a real estate salesman that they will make money hand over fist, when they do not do so.

Cooperatives were expensive in the beginning. When a cooperative is started, all you have is so many growers agreeing to ship through one unit. You must advertise, you have no money, no stock, so you must take the merchandise and sell it. You finally make the first payroll. Over a period of years, the cost of operating comes down far below the cost of selling in any other manner.

We have complaints sometimes for high costs. Last year the cost of selling and general overhead expense, including printing of office forms, accounting, collections, salesmen and manager salaries, was 7% of all the money received from fruit net to the grower. A few years ago we were higher than commission men. Over a period of years if the growers maintain confidence in the directors and manager, that cost of doing business comes down to a point where it is economically unsound for a grower to sell any other way.

Some folks get independent, as the previous speaker indicated, and they want to sell their own merchandise. Now, I know nothing about farming, but have spent about twenty years in selling. I could not have known a great deal about selling if I had been in some other line. The same thing is true of farming.

You have a cooperative, a manager who knows executive work, who has executive ability, a sales manager, and an accounting officer. All these men are specialists. They are just as much a specialist in their lines as you are specializing in date farming.

Perhaps one man won't know much about raising avocados, with all its problems. It would take you some time to learn. This is what you have to learn about avocados. A good many of my relatives are in the middle west, and not a salesman in the bunch. You are handicapped if you sell alone, because the man to whom you are selling is probably a specialist in buying. It is too much competition for you. For that reason, cooperative marketing has been most successful in California. It has been so successful that when the Government steps in to give the farmer some relief, President Hoover had little to offer except the cooperative marketing priniciple. This is about the only relief you can give a farmer. The cooperative marketing principle is backed up by the Government.

I will take a few minutes to tell you what we do. I believe that, as far as sales methods are concerned, that our fruit is comparable to your own. It was a tropical fruit. There are a great many varieties. We have 15 or 20 sizes, 8 or 10 groups of quality. It was impossible to educate the people into these differences, so we sorted into a general package. We hammered away on the public consciousness until finally they bought. We put out good fruit. We sold the public the idea of serving avocados as something smart to do. This was because the price was so high—the cost of moving very high. Since we have a larger crop each year, we have got to get down to the problem, as just another fruit. Now we are trying to sell them on the basis of eating avocados for energy. First it tastes good, then its good for you.

First, we sold the grocer one avocado, then half a dozen, then enough to make a nice display. We would cut the fruit and give the clerks and store managers samples. What was left would be given to customers. That costs money. This was the first time. However, by contacting 30 or 40 housewives, and arousing enthusiasm in the clerks and manager, the next order was for a dozen or more. With this principle, we went from one grocer to another. Then they bought a box at a time. We have since, after using this principle, found it necessary to continue.

We have a special crew to contact all the retailers in the chain stores, hotels, dining cars, etc. We hire demonstrators, and average 25 demonstrations each week. There are 40 weeks in our shipping schedule, 25 demonstrations each week, would give a thousand in a season.

You would be surprised at the number of people who sample avocados. We have had as many as 4,500 samples a day passed out in various demonstrations.

All this has led up to increased sales, to the point where demand for avocados, despite the fact that it is a highly perishable, relatively unknown product, has outclassed pro-

duction. Within the last 12 days we have raised the price four times. These raises were due to the fact that at this season, through sales promotion work, we have been able to create more demand for the fruit.

This is rather outstanding this season, particularly in the produce industry. This is primarily a season of low prices. Most products are selling lower than cost of production. We have brought up this demand primarily with those principles and policies. We have found it necessary, in certain cities, to have distributing agencies. In every branch office we operate a staff of representatives who call on the retail and wholesale trade to do the sales promotional work. They hit each city about three times during the shipping season—once at the beginning, again about 30% to 40% through the season, and the last time just before the shipping is finished.

This is not an economical plan, but you will find it cheaper for some products to take the most expensive cost per contact, because of the fact that housewives read advertisements several times before they buy. But if she gets a sample, she probably will buy it that same week and continue buying if she likes it. We will continue to expand these same policies because of the fact of their success.

I believe it would work in your industry. There are several things similar to the problems we have. It is possible that these ideas will do you a whole lot of good. The successful operation of this policy is merely obtained by the expenditure of advertising money. We have been advertising about six years now. We have spent a lot of money on advertising. This is not an expense. Advertising is an investment. You should not advertise any product unless you do it each season. If you are going to advertise just one year, keep the money in your pocket. Possibly the second and third years you can cut down a little bit. You cannot perform miracles with paper and ink. If you cannot afford to advertise over a long period of time, don't advertise.

Perhaps you would be interested in knowing the division of our advertising money—50% of the advertising budget, which is set at so many cents per pound of avocado handled, is put into man power. Man power sells the idea. They make the contacts mentioned. When they make contacts, they must have booklets and pamphlets to leave, showing how to take care of the fruit, how to handle it, the price of it, what to expect of it. There must be two or three kinds for the housewife, so that it will give variety.

Of the 50% that is left then, we spend one-third in space advertising in magazines, etc. We spend a small part for office overhead, keeping advertising records, etc. The balance is primarily spent for printed advertising material for display purposes, dealer, jobber, and inquiry helps. In different seasons of the year we get out display boxes, etc., around the country.

We have found this to be the best division of our advertising money to get the quickest returns for our crop movements. In other lines, this division might not work. In ours it works best.

In summing up these things, we find that the movement of our particular crop is one not difficult, but merely takes watching all the factors, which are (1) demand and trend of demand, best evidenced by amount of sales promotional work you do; and (2) in watching the supply.

When the demand is a little better than supply, then you have increased the demand, you can afford to raise your price, and vice versa, you lower prices.

It is not particularly difficult to be successful in these instances. It is merely a matter of watching and having sufficient experience to know what you are watching. If your growers are headed by the right board of directors, and they have selected the right manager, you make good. Another important factor is changing of managers. All cooperatives and business men make mistakes. We Calavo growers have perhaps made all the mistakes ever listed. If every year our board of directors had discharged our general manager, since every man makes mistakes, perhaps the new manager would make the same mistakes over again, while the old one would probably not make the same mistake twice.

In selecting your manager, you must remember that he is bound to make a few mistakes. You must have patience with him. Perhaps he will also save you five times the amount he might lose for you. This will show up in all cooperative movements. If he makes the mistake, he probably will not make it the second time.

One thought I would like to leave with you, you must stick together. There are two maxims that are true to any cooperative: "United you stick, divided you're stuck." Whenever you think of leaving the cooperative, remember the banana. "When it leaves the bunch, it gets skinned."

Mr. Haywood: What percentage of your demonstration cost on your sales price?

Mr. Humason: We will have an average demonstration cost of about $8.25 per day, including time and all other materials it takes to make an attractive display table. We will have approximately 1,000 of these a year. This year we will have 320,000 pieces of fruit, at an average price of approximately $2.25. This would be approximately $825,000. This figure is just a guess. I rather believe that our sales this year net in Los Angeles will be in excess of three-quarters of a million.

Mr. Haywood: You have increased the price four times in the last 12 days. What is the total percentage of the increase?

Mr. Humason: They have averaged about 16%. I think they will have another next week.

Mr. Haywood: Please repeat the division of advertising money.

Mr. Humason: About as follows: 50% for promotional sales, 10% office overhead, 20% space advertising, 20% other types of advertising.

Mr. Swingle: What part of the demonstration cost is in the samples of fruit given away?

Humason: The cost of $8.25 included the fruit. The demonstrator's salary is $4.50 per day, 50c for salad dressing, etc., all that is left will go to pay for our own fruit.

The Effect of Heat on the Germination of Date Pollen

By Bryson Gerard, Formerly Field Assistant, U. S. Experiment Date Garden, Indio, California

DURING the flowering season of 1931 a series of experiments were conducted at the U. S. Experiment Date Garden, Indio, California, to determine the effect of heat on the viability of date pollen.

Samples of fresh pollen were subjected to temperatures from 140° to 190° F. in a small electric oven. Each sample to be tested was spread as thinly as possible in shallow cardboard boxes approximately two inches square. When the oven had reached the consistent temperature desired by Professor D. W. Albert as reported in his paper at the Seventh Annual Date Growers' Institute. Ob- the boxes were quickly placed within and allowed to remain the specific number of minutes. After the exp sure to heat the pollen was allowed to cool then transferred to an incubation cell for germination. The method employed to produce artificial germination was similar to that used servations of the pollen were made with a microscope under high power magnification.

EFFECT OF HEAT ON THE GERMINATION OF POLLEN

Duration of Exposure			
At 140° F.		**Fard No. 4 Pollen**	**Mosque Pollen**
Before heating	Germination	90%	89%
15 min.	"	70%	82%
30 "	"	62%	66%
45 "	"	48%	31%
60 "	"	28%	36%
75 "	"	no test	18%
At 160° F.		**Fard No. 4 Pollen**	**Mosque Pollen**
Before heating	Germination	87%	87%
15 min.	"	63%	72%
30 "	"	59%	53%
45 "	"	38%	18%
60 "	"	15%	no test
75 "	"	2%	0
90 "	"	0	no test
At 170° F.		**Fard No. 4 Pollen**	
Before heating	Germination	87%	
15 min.	"	42%	
30 "	"	36%	
45 "	"	19%	
65 "	"	1%	
At 190° F.		**Fard No. 4 Pollen**	**Maktum No. 6 Pollen**
Before heating	Germination	87%	85%
15 min.	"	18%	0
60 "	"	0	0

The results of these tests show a consistent decrease in the percentage of germination in direct proportion to the increase in temperature or the duration of exposure.

Somewhat comparable results were obtained from samples of pollen stored in a wooden, glass-covered box exposed to direct sunlight. Maximum temperatures within such a chamber ranged from forty to sixty degrees higher than the outside air.

These experiments indicate that in drying and storing pollen which is to be held for any length of time, exposure to high temperatures should be avoided.

DISCUSSION

Mr. Nixon: Numerous experiments were made on the duration of the pollen in the laboratory by Dr. Stout and Mr. Gerard. In nearly every case, we have failed to get germination after one year's time. A few cases have shown a small percentage in the laboratory, but in the field it fails to give results. The case mentioned by Professor Albert was pollen stored, sealed and kept in cold storage. If there are any growers here from Imperial Valley, they can confirm my observations as to the failure of old pollen. One of the most striking cases I have ever seen of this failure occurred on the Reed Ranch last year. The new man in charge was told that old pollen was all right and used it. I was down there in the fall and on many palms throughout the garden I found no dates at all. On a few bunches blooming late in the season was a fair set. I asked about these bunches and he said that he had mixed a little fresh pollen with the old pollen in this case. There was about a 90% loss due to the use of old pollen.

Convenient and Satisfactory Storage House for Pollen

By H. R. Whittlesey, Superintendent Krutz Ranch, Indio, California

I HAVE been asked to describe a house which I designed and built several years ago for the storage of pollen at the Krutz Ranch and which has been found very convenient and satisfactory in every respect.

Essentially it is a narrow, upright cupboard or compartment with a series of removable, screen-bottom shelves in the upper part, a funnel-shaped tin tray below the last shelf for catching the shattered pollen and two shelves at the bottom for supplies. A can below the funnel receives the dry pollen as it sifts down from above.

Air circulation, necessary to dry the pollen and to prevent mould, is provided by a sheltered screen vent above and across the door beneath the projecting roof which slants back and down from the front.

In storing the fresh pollen I cut the strands from the male cluster and spread them in the screen-bottom trays, as a large compact male bloom will not dry out properly if left entire.

The first house built and used continually since is 24 in. wide, 20 in. deep, and 6 feet high in front. It was constructed of the material listed below at a cost of $11.47. The dimensions, of course, are a matter of individual preference, but the principle involved in construction has proved sound.

I prefer a small house which can be moved easily and as our extensive acreage comes into bearing I plan to use several such units, placing them at convenient locations in the garden during the pollination season.

List of Material

2 pieces 1x4, 8 ft. long, to reinforce presdwood door

5 pieces 2x3 10 ft. long, for frame

4 pieces 1x3, 8 ft. long, for making screen trays

1 piece 1x12, 12 ft. long, for three shelves

1 piece 4 ft. x 12 ft. presdwood, makes the four sides complete

1 piece 3 ft. x 12½ ft. long, for roof

9 lin. ft. 24. in. gal. screen, for trays and vents.

1 lb. 10d box nails

1 lb. 3d blued nails

1 safety hasp

1 pr. 3 in. Tee hinges

1 2-ft. x 2-ft. funnel tray.

Date Palm Plantings in Coachella Valley

April 1932

Standard Varieties

1-4 years old	62,517	
5-9 years old	29,279	
10 years old	16,581	
In Nursery	25,157	
Total Standard Varieties		133,534

Seedling Palms

Males	4,222	
Ornamentals	2,267	
Commercial	10,368	
Seedling of no value	13,594	
Total Seedling Palms		30,451
Total Date Palms		163,985